

Description and molecular characterization of six new species of *Nassarius* (Gastropoda, Nassariidae) from the western Pacific Ocean

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Abstract: Six new species of the genus *Nassarius* Duméril, 1805 are described, based on material collected from the Coral Triangle and the South Pacific. We combine traditional morphology-based descriptions with the molecular (Cytochrome c oxidase I - COI) signature of the new species. New species are: *Nassarius ocellatus* sp. nov. (Philippines to Vanuatu), *Nassarius houbrocki* sp. nov. (Solomon Islands to Queensland and Tonga), *Nassarius radians* sp. nov. (Philippines to Vanuatu), *Nassarius vanuatuensis* sp. nov. (Vanuatu), *Nassarius velvetosus* sp. nov. (Western Australia to Fiji) and *Nassarius martinezi* sp. nov. (Solomon Islands to Tonga).

Key words: Buccinoidea, taxonomy, misspelling, species complex, protoconch

Over the last three decades, the Muséum national d'Histoire naturelle (MNHN) has carried out many expeditions to explore the benthic biota of the Indo-Pacific biogeographic region (e.g., Bouchet *et al.* 2008, 2011), resulting in a fair representation of the mollusk diversity. After the molecular systematic revolution, those samplings have included DNA collections besides the traditional dried shells, thus integrating the molecular component to the international network of traditional taxonomic experts involved in the study of MNHN expedition's material (e.g., Puillandre *et al.* 2010, Fedosov and Puillandre 2012, Kantor *et al.* 2012, ter Poorten 2012).

After all these years, a significant collection of Nassariidae has been brought together. The number of recent species in the family was 319 at the time of Cernohorsky (1984), the last comprehensive revision. Since then, approximately 60 new species have been described, and a few nominal species, treated as synonyms by Cernohorsky, have been revalidated. The current known diversity of the family stands at 420 valid species (see WoRMS, <http://www.marinespecies.org/>), of which 85% is classified in the subfamily Nassariinae; the genus *Nassarius* Duméril, 1805 alone, in a broad taxonomic extension, accounts for 336 valid species. Molecular data on Nassariidae are still meager (Couceiro *et al.* 2007, 2012, Li *et al.* 2010), and a molecular phylogeny of the Nassariinae, which will lead to a revised generic classification, is currently underway (Galindo, Ph.D. work in progress).

As with the rest of shelled mollusks, species discrimination in the Nassariidae is traditionally based exclusively on features such as shell shape and sculpture. In a minority of cases, the protoconch, radula, and egg capsules are also used

as taxonomical characters (e.g., Kantor and Kilburn 2001, Li *et al.* 2010, Yang and Zhang 2011). In the present paper, we describe several species regarded as new based on a suite of their shell characters, but we also include the COI sequence in the holotype designation, so they constitute the hologenophores in the sense of Pleijel *et al.* (2008).

MATERIALS AND METHODS

Abbreviations used along the text are as follow: BOLD: Barcode of Life Database; CP: Beam trawl; dd: empty shell; DW: Warén dredge; HK: Private collection H.H. Kool; juv: juveniles; lv: live-collected specimen; MNHN: Muséum national d'Histoire naturelle, Paris, France; NHMUK: British Museum of Natural History, London, UK; RMNH: Naturalis Biodiversity Center, Leiden (formerly Rijksmuseum van Natuurlijke Historie, Leiden, The Netherlands); Stn: Station number; WoRMS: World Register of Marine Species; WAM: Western Australian Museum.

Live-taken specimens were preserved in the field in 90% or 98% ethanol for molecular analysis by cutting pieces of the head-foot from anaesthetized (MgCl₂) specimens. In the laboratory the bodies were separated from the shells to prevent the progressive deterioration of the shells by etching. The shells were kept dry and carry the same registration number as the corresponding body or tissue in 95% ethanol.

A stereomicroscope was used to observe shell morphology and color patterns. A digital vernier (accurate to 0.1 mm) was used for measurements. Shells of the new species were photographed in dorsal, ventral and lateral view using a

Table 1. GenBank and BOLD numbers for the sequence obtained from the described new species of *Nassarius*. H: holotype, P: paratype.

ID number	Species (sp. nov.)	Status	COI BOLD	COI GenBank
IM200731906	<i>Nassarius ocellatus</i>	H	NASSA001-12	
IM200731907	<i>Nassarius ocellatus</i>	P	NASSA002-12	
IM200736143	<i>Nassarius houbricki</i>	H	NEOGA1175-12	KC970035
IM200736147	<i>Nassarius houbricki</i>	P	NEOGA1172-12	KC970034
IM200736148	<i>Nassarius houbricki</i>	P	NASSA004-12	
IM200736179	<i>Nassarius houbricki</i>	P	NEOGA1171-12	KC970033
IM200912244	<i>Nassarius houbricki</i>		NEOGA1174-12	KC970032
IM200912277	<i>Nassarius houbricki</i>		NEOGA1186-12	KC970030
IM200912279	<i>Nassarius houbricki</i>		NEOGA1185-12	KC970031
IM200731656	<i>Nassarius radians</i>	P	NEOGA1188-12	KC970054
IM200731658	<i>Nassarius radians</i>	P	NEOGA1189-12	KC970057
IM200731659	<i>Nassarius radians</i>	P	NEOGA311-10	KC970051
IM200731660	<i>Nassarius radians</i>	P	NEOGA312-10	KC970056
IM200731672	<i>Nassarius radians</i>	P	NEOGA1173-12	KC970053
IM200731685	<i>Nassarius radians</i>	H	NEOGA334-10	KC970055
IM200731686	<i>Nassarius radians</i>	P	NEOGA335-10	KC970052
IM200731729	<i>Nassarius radians</i>	P	NEOGA360-10	KC970058
IM200731734	<i>Nassarius vanuatuensis</i>	H	NEOGA362-10	KC970062
IM200731735	<i>Nassarius vanuatuensis</i>	P	NEOGA363-10	KC970061
IM200731785	<i>Nassarius vanuatuensis</i>		NEOGA392-10	KC970060
IM200731786	<i>Nassarius vanuatuensis</i>	P	NEOGA393-10	KC970059
IM200731709	<i>Nassarius velvetosus</i>	H	NEOGA1187-12	KC970064
IM200920616	<i>Nassarius velvetosus</i>		NEOGA1178-12	KC970063
IM200734766	<i>Nassarius martinezi</i>	P	NEOGA798-10	KC970050
IM200734768	<i>Nassarius martinezi</i>	P	NEOGA799-10	KC970049
IM200735021	<i>Nassarius martinezi</i>	H	NASSA005-12	KC970038
IM200735030	<i>Nassarius martinezi</i>	P	NEOGA821-10	KC970048
IM200735031	<i>Nassarius martinezi</i>	P	NEOGA822-10	KC970047
IM200735032	<i>Nassarius martinezi</i>	P	NEOGA823-10	KC970046
IM200735965	<i>Nassarius martinezi</i>		NEOGA1177-12	KC970036
IM200735992	<i>Nassarius martinezi</i>		NEOGA857-10	KC970045
IM200735995	<i>Nassarius martinezi</i>		NEOGA1176-12	KC970037
IM200736807	<i>Nassarius martinezi</i>	P	NEOGA1183-12	KC970040
IM200912252	<i>Nassarius martinezi</i>		NEOGA1182-12	KC970041
IM200912253	<i>Nassarius martinezi</i>		NEOGA1181-12	KC970042
IM200912254	<i>Nassarius martinezi</i>	P	NEOGA1180-12	KC970043
IM200912255	<i>Nassarius martinezi</i>	P	NASSA003-12	
IM200912256	<i>Nassarius martinezi</i>	P	NEOGA1179-12	KC970044

Nikon D70S camera and, for small samples, a Nikon D5000, associated to a stereomicroscope Leica MZ16. Macro images were achieved by integrated partial focused slices by the software CombineZ5.3 (Hadley 2006). To enhance details of shell surface, a photo was taken after coating with magnesium salt. The scanning electron microscope (SEM) images of protoconchs were obtained on the Jeol JSM5410LV Low Vacuum Scanning Microscope at the Centre de Recherche sur la Conservation des Collections (MNHN-MCC-CNRS USR 3224).

Molecular sequencing was carried out at the Service de Systématique Moléculaire (MNHN- Paris VI UMR 7138 UMS

2700). Procedures from Consortium for the Barcode of Life barcoding protocols (www.barcodeoflife.org) adapted to large biodiversity collections were followed (*sensu* Puillandre *et al.* 2012). To constitute a reference tissue collection, a piece of muscle from the foot, large enough for approximately five DNA extractions, was stored in a 2D barcode tube. A second 2D tube was used to store PCR products from extraction. Extraction was done using QIAamp DNA Micro Kit (Qiagen, Stanford, CA, U.S.A.). A fragment of 658 bp of the Cytochrome Oxidase I (COI) mitochondrial gene was amplified, using the universal set of primers (LCO1490 and HCO2198) (Folmer

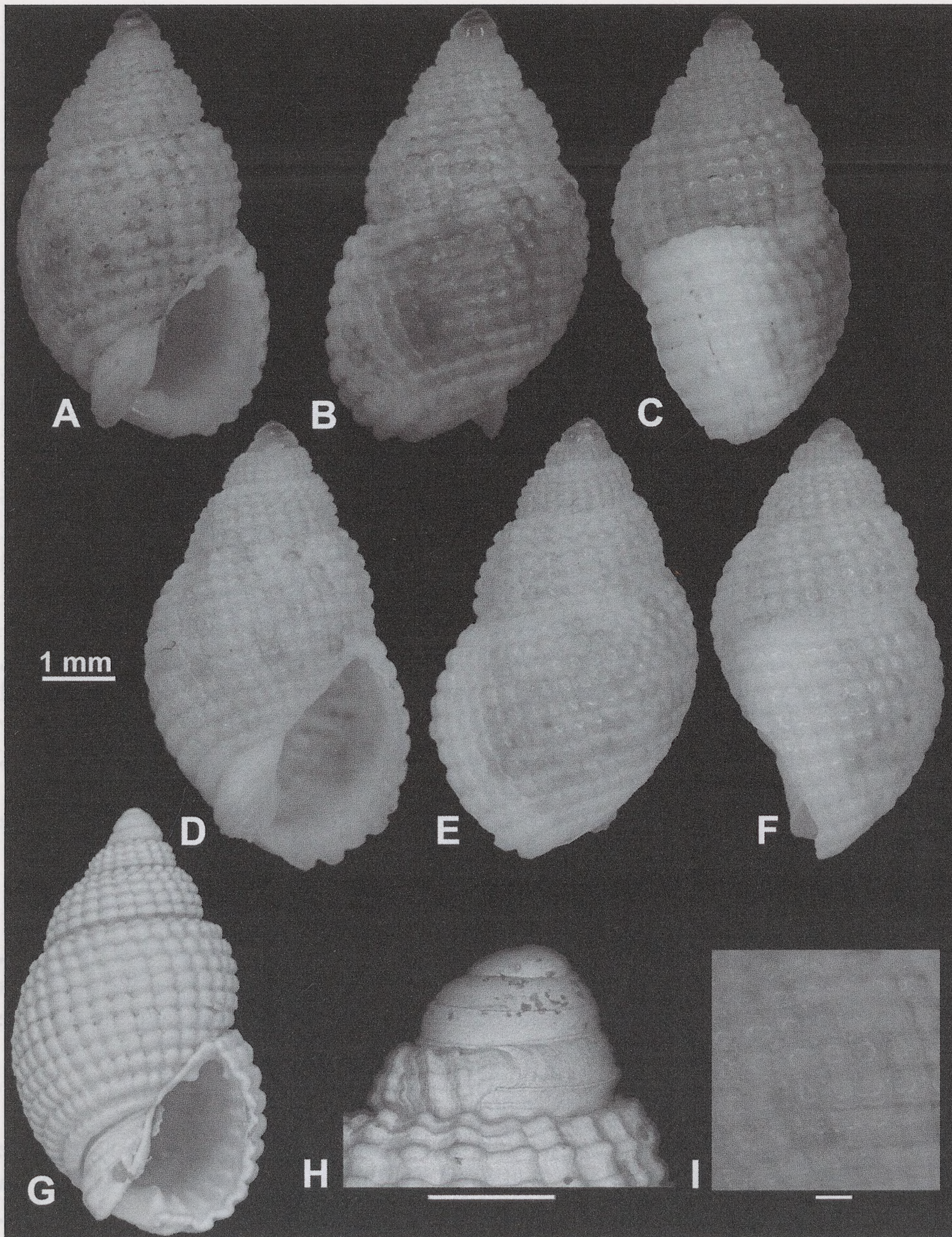


Figure 1. *Nassarius ocellatus*, sp. nov. A–C, holotype MNHN IM 2007-31906, h 5.9 mm, w 3.2 mm, Philippines, Panglao Island, 9°35'N, 123°51'E, 80 m. D–G, paratype MNHN IM 2009-13090, h 6.5 mm, w 3.5 mm, Philippines, Panglao Island, 9°29'N 123°52'E, 95–128 m. H, protoconch of paratype. I, Enlarged shell sculpture. Scale bars: H and I = 250 μ m.

et al. 1994). PCR reactions were performed in 20 μ l, containing between 1 and 2 μ l of DNA, 1X reaction buffer, 2.5 mM $MgCl_2$, 0.26 mM dNTP, 0.3 μ M of each primer, 5% DMSO and 5% BSA (10 mg/l) and 1.5 units of Q-Bio Taq, (QBiogene, Carlsbad, CA, U.S.A.). Thermocycles used for COI gene are those described in Hebert *et al.* (2003). Annealing temperature was 54 °C for 40 seconds. Sequencing was carried out by the Centre National de Séquençage (Genoscope-France). In all cases, both

directions were sequenced to confirm accuracy of each haplotype. Sequence cleaning and alignment was done by Codon Code Aligner software. Once having validated the sequence by Blast search in the National Center for Biotechnological Information (NCBI) databases, the vouchers were submitted to the Barcode of Life Database (BOLD) and the corresponding sequences into GenBank. References to all the sequences obtained are included in Table 1.

We compiled a dataset of COI sequences available for several closely related species identified in a phylogenetic tree based on a large dataset of Nassariidae (GenBank and MNHN unpublished data) to compare with our new species' hypothesis. The analysis involved 95 COI sequences: 41 belong to the new species, 43 sequences belong to MNHN sequences from the following Nassariidae, 7 sequences were taken from GenBank depositary and 4 outgroups (Table S1; see supplemental document at: http://www.bioone.org/doi/suppl/10.4003/006.032.0202/suppl_file/Kool_2014_Suppl.pdf).

A Bayesian analysis, consisting of two Markov chains (10 million generations each with a sampling frequency of one tree per each hundred generations) run in eight parallel analyses was performed using MrBayes v. 3.1.2 (Ronquist and Huelsenbeck 2003). When the log-likelihood

scores were found to stabilize, a consensus tree was calculated after omitting the first 25% trees as burn-in. The phylogenetic analysis was performed using the CIPRES Science Gateway (Miller *et al.* 2010). Kimura 2-parameter (K2P) distances, estimated with MEGA 5 (Tamura *et al.* 2011), were used to compare each new species with its relatives as defined above.

All the material (type series and sequences) is in MNHN unless mentioned otherwise. Detailed information on tropical

deep sea surveys program run by MNHN (from which we obtained the new species described) can be found in Bouchet *et al.* (2008).

SYSTEMATICS

Family Nassariidae Iredale, 1916 (1835)

Subfamily Nassariinae Iredale, 1916 (1835)

Genus *Nassarius* Duméril, 1805

Type species (by subsequent monotypy, Froriep, 1806). — *Buccinum arcularia* Linnaeus, 1758. Recent.

Nassarius ocellatus new species (Figs. 1 and 2)

Type material

Holotype MNHN IM 2007-31906; BOLD ID = NASSA001-12 (Fig. 1A–C) (height 5.9 mm, width 3.2 mm). Eight paratypes MNHN: Philippines, West Pamilacan Island, 9°29'N, 123°52'E, 95–128 m, 1 dd, height 6.5 mm, width 3.5 mm (MNHN IM 2009-13090) (Fig. 1D–H); 1 dd (MNHN IM 2000-25418); Philippines, Panglao Island, 9°35'N, 123°51'E, 80 m, 1 lv (MNHN IM 2007-31907); Philippines, Bohol Sea, off Balicasag Island, 9°32'N, 123°42'E, 111–115 m, 1 dd (MNHN IM 2000-25420); Philippines, 16°04'N, 121°56'E, 111–113 m, 4 dd (MNHN IM 2000-25419).

Type locality

Philippines, Panglao Island, Biking, Catarman, 9°35'N 123°51'E, 80 m.

Additional material (See supplemental document at: http://www.bioone.org/doi/suppl/10.4003/006.032.0202/suppl_file/Kool_2014_Suppl.pdf)

Description

Shell oval and glossy. Height 5.9 mm and width 3.2 mm. Planktotrophic protoconch with 3 whorls, shiny and carinated (Fig. 1H protoconch of paratype MNHN IM 2009-13090). First 1.5 whorls colored in intense reddish brown. Teleoconch of 3.5 convex whorls, last whorl bulbous. Whole shell longitudinally ribbed. Last whorl with approximately 25 axial ribs, equally strong and evenly spaced; spiral sculpture consists of 6 deep spiral grooves on the penultimate whorl and 10 on the last whorl. Ribs and grooves result in quadrangular tubercles and glassy interspaces (Fig. 1I). Siphonal area with 3 cords. Siphonal canal short. Suture deeply impressed and channeled. Aperture oval, outer lip slightly thickened, not variced, crenulated, 10 lirae within. Columella slightly calloused, smooth, parietal denticle strong, anal canal prominent. Color whitish to creamy yellowish, reddish brown mottled; last axial ribs of body whorl, aperture and columella white.

Intraspecific variation: All available adult specimens are comparable in size and color.

Distribution

Nassarius ocellatus sp. nov. was found alive in 80 m, empty shells are recorded down to 201 m. The species is known from the Philippines, Indonesia, Vanuatu and the Solomon Islands (Fig 2).

Discussion

The combination of the shape, the tubercular sculpture of quadrangular knobs, the reddish part of the protoconch and the crenulated outer lip make *Nassarius ocellatus* sp. nov. easy to distinguish from all other known species in the family Nassariidae. *Nassarius ocellatus* sp. nov. is figured in Poppe (2008: 125, plate 357, Fig. 2) as *N. multigranosus* (Dunker, 1847), but according to Tsuchiya (*in* Okutani 2000: 449; plate 223, Fig. 61) that species is granulated and larger sized. The lectotype of *N. multigranosus* is figured by Cernohorsky (1984: plate 39, Fig. 1). The axial ribs are stronger, the granules are smaller and the protoconch is sharper. The distribution of *N. multigranosus* is limited to Japan and Korea.

Etymology

From the Latin word *ocellus* = little eye, with reference to the chestnut brown “eye” at the top of the protoconch.

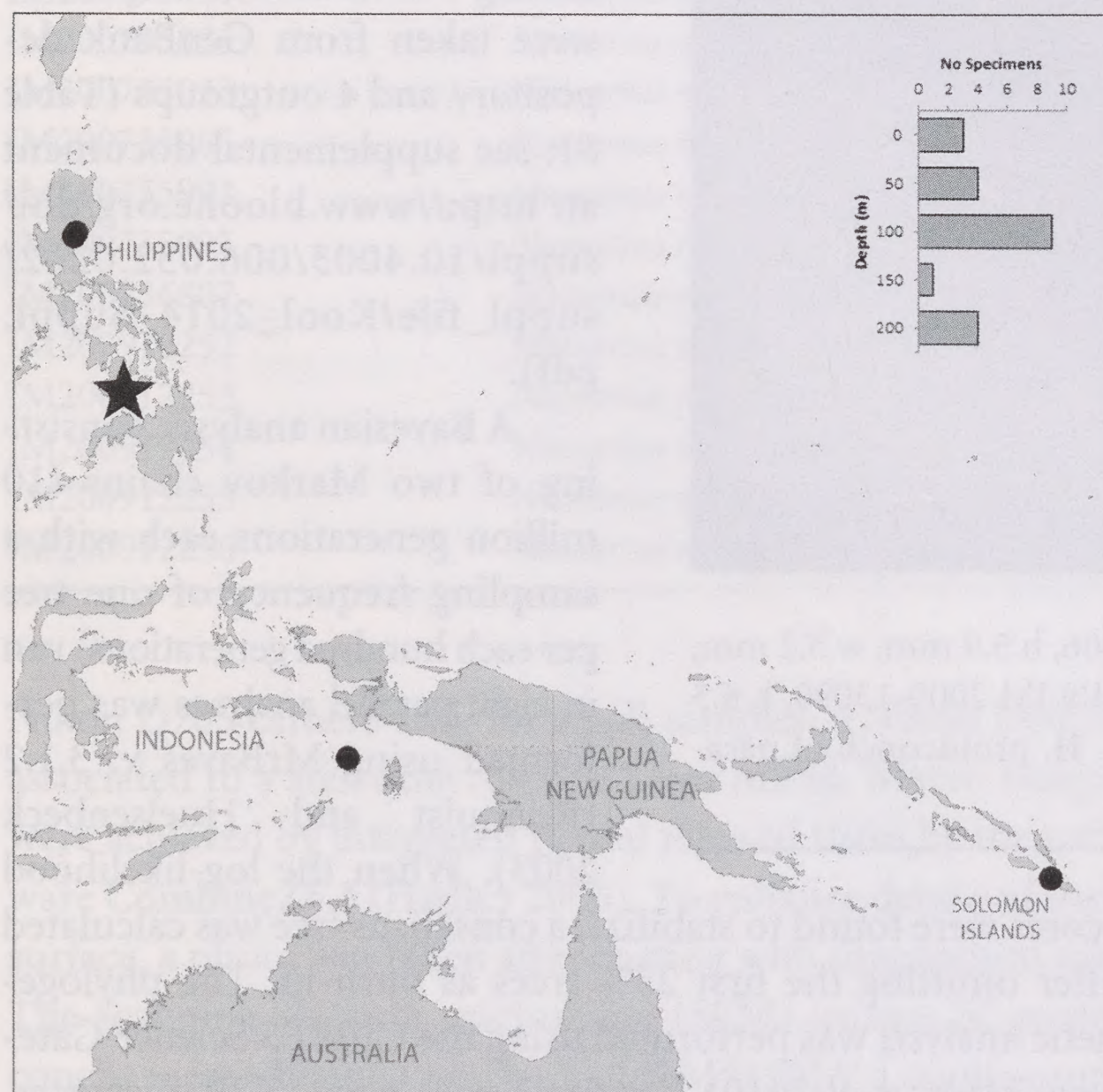


Figure 2. Geographical and bathymetrical distribution of *Nassarius ocellatus* sp. nov. Each bar represents all lv or dd specimens. Star indicates type locality.

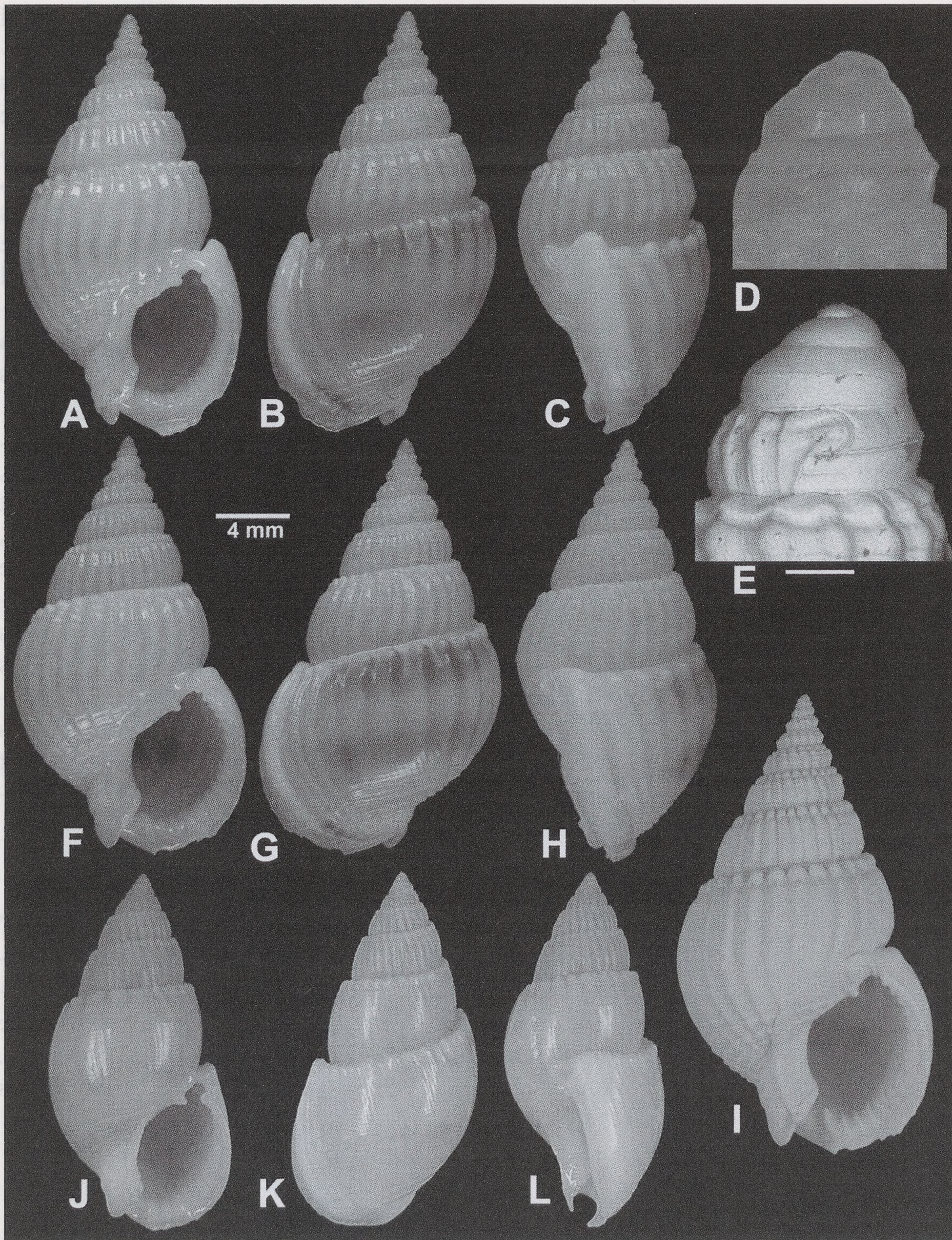


Figure 3. *Nassarius houbrieki*, sp. nov. A–E, holotype MNHN IM 2007-36143, h 22.6 mm, w 11.4 mm, Solomon Islands, East Malaita, SALOMONBOA 3, stn CP2804, 09°15'S, 161°21'E, 150–175 m. D–E, protoconch of the holotype, scale bar: D 250 µm. F–I, paratype MNHN IM 2007-36148, h 28.3 mm, w 13.1 mm, Solomon Islands, East Malaita, SALOMONBOA 3, stn CP2804, 09°15'S, 161°21'E, 150–175 m. *Nassarius alabasteroides* Kool 2009. J–L, holotype MNHN IM 2000-21889, h 24.7 mm, w 11.6 mm, Coral Sea, Banc Capel, MUSORSTOM 5: stn DW270, 24°49'S, 159°34'E, 223 m.

***Nassarius houbrieki* new species**
(Figs. 3 and 4)

Type material

Holotype MNHN IM 2007-36143; BOLD ID = NEOGA 1175-12; GenBank accession number for COI = KC970035

(Fig. 3A–E) (height 22.6 mm, width 11.4 mm). Four paratypes MNHN: Solomon Islands, East Malaita, SALOMONBOA 3, stn CP2804, 09°15'S, 161°21'E, 150–175 m, 1 lv, height 28.3 mm, width 13.1 mm (MNHN IM 2007-36148) (Fig. 3F–I); 1 lv juv (MNHN IM 2007-36147); 1 lv juv (MNHN IM 2007-36179); Solomon Islands, South Malaita, SALOMONBOA 3, stn CP2814, 09°45.00'S, 161°33'E, 375–431m, 1 dd juv (MNHN IM 2000-25425).

Type locality

Solomon Islands, East Malaita, 09°15'S, 161°21'E, 150–175 m [SALOMONBOA 3, stn CP2804].

Additional material (See supplemental document at: http://www.bioone.org/doi/suppl/10.4003/006.032.0202/suppl_file/Kool_2014_Suppl.pdf)

Description

Shell elongate ovate, height 22.6 mm, width 11.4 mm, thin and shining. Planktotrophic protoconch (Fig. 3D–E) approximately 3.3 whorls, last 1.5 carinated. Teleconch 7.5 convex whorls, regularly ribbed, dorsal side of last whorl with ribs only unto periphery, lower part smooth, aside from 3 axial ribs towards outer lip, last one prominent; edge of outer lip thin. Suture channeled, at the last whorl accentuated by ribs higher than bottom of channel. Penultimate whorl with approximately 30, last whorl with 22 ribs. First 5 teleconch whorls with 1 to 2 prominent spiral cords, strongest one below suture, causing fine glistening beads near suture; last 2 whorls with shallow groove below suture, getting less prominent towards outer lip. Five spiral grooves at base, siphonal area with 3 cords.

Aperture oval, outer lip thin, inside with approximately 15 short, evenly-sized lirae. Columella with 1 to 2 weak folds,

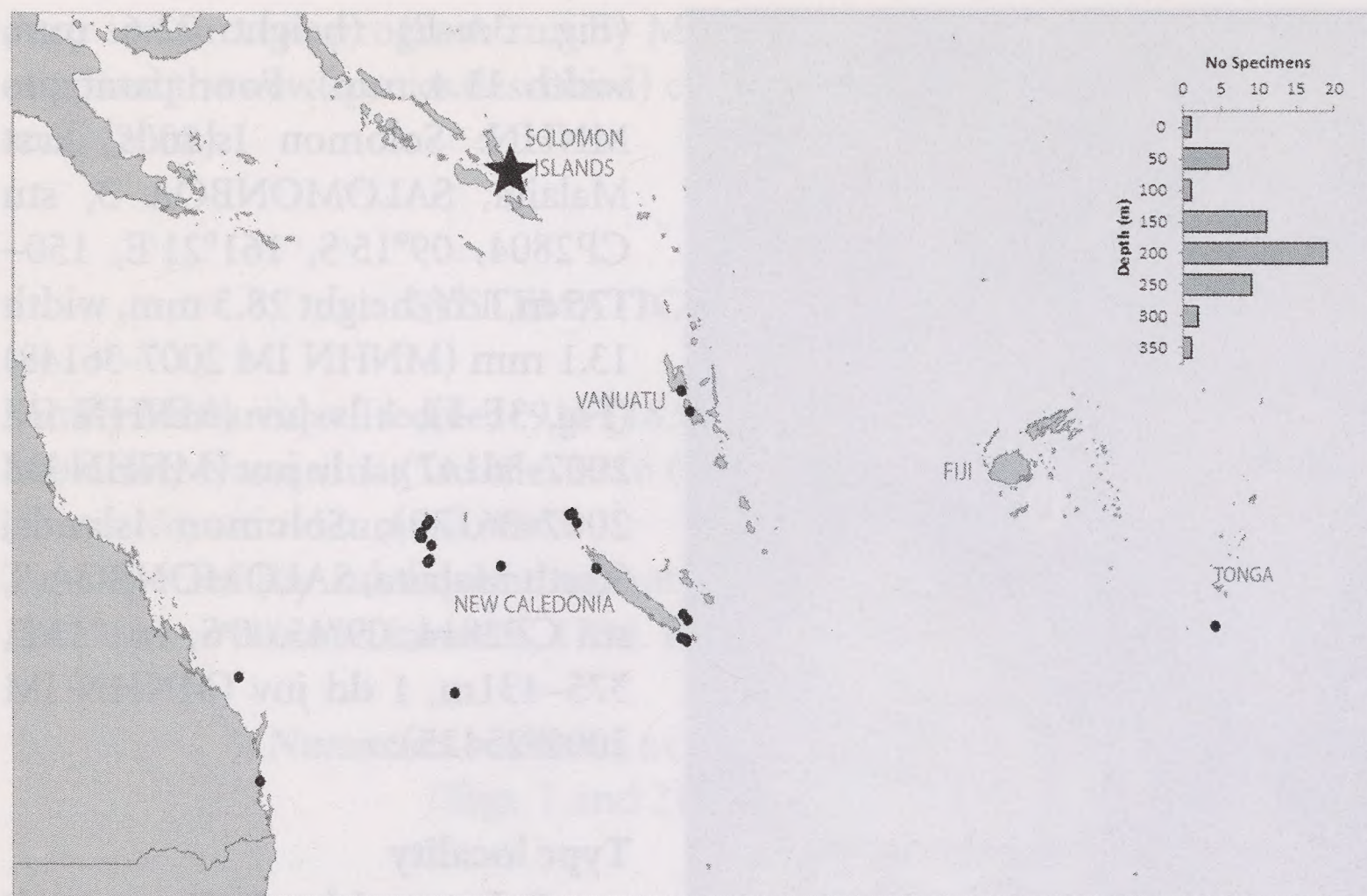


Figure 4. Geographical and bathymetrical distribution of *Nassarius houbricki* sp. nov. Each bar represents all lv or dd specimens. Star indicates type locality.

basal cords visible; callus anteriorly laminate, posteriorly thinning and slightly extending over last whorl. Some callosity near anal canal; parietal denticle prominent, anal canal wide. Operculum not present in holotype, yellow in other specimens.

Intraspecific variation: Color varies from white to pale yellow, on dorsal side of last whorl, below suture, a chestnut-brown band; on periphery and at base a paler band. Size of adult specimens from 22.5 mm to 30.5 mm.

Distribution

Found in Australia (Queensland), New Caledonia, Vanuatu, Solomon Islands and Tonga (Fig. 4). Coral sand at depths, ranging from 62 to 375 m.

Discussion

Nassarius houbricki sp. nov. may be compared with *Nassarius siquijorensis* (A. Adams, 1852) and *Nassarius alabasteroides* Kool, 2009. Cernohorsky (1991: 201) misidentified specimens of *Nassarius alabasteroides* Kool, 2009 (Fig. 3J–L) and *N. houbricki* sp. nov. as *Nassarius* (Zeuxis) *siquijorensis* (A. Adams, 1852). *Nassarius siquijorensis* (discussed and figured by Kool (2007: 89; Figs 17–20)) is finely ribbed all over the shell and not as thin and light in weight as *N. houbricki* sp. nov. The distribution of *N. siquijorensis* as established by Cernohorsky (1991: 202) ranges from the Red Sea to Japan and New Caledonia, but Kool (2009: 98) showed that it is limited to the western Pacific; it occurs neither in Japan nor in the Red Sea. Tsuchiya (*in* Okutani 2000: pl. 221, Fig. 35) figured a specimen of *N. euglyptus* (Sowerby III, 1914) from Japan under the name *N. siquijorensis* (Kool

2007: 89; Figs. 13–16). Also, the occurrence of *N. siquijorensis* in New Caledonia is a misidentification with *N. alabasteroides* Kool 2009 [Lots mentioned by Cernohorsky (1991: 201–202): DC63, DC84, DC66, DC67, 258, 263, 265, 266, 270, 276, 289, 293, 294, 295, 296, 312, 315, 318, 320 and CC175] and *N. houbricki* sp. nov. [Lots mentioned by Cernohorsky (1991: 201–202): DC 33, CP10, 284, 347, DW151, DW186 and DW367]. *Nassarius alabasteroides* is distinguished from *N. houbricki* sp. nov., because is more elongate, taller, lighter and by its less prominent ribs.

Loch (1992: 1) figured *Nassarius houbricki* sp. nov. under the name *Nassarius* cf. *psila* (Watson, 1882), from Queensland, off Raine Islands at a depth of 284 m. Cernohorsky (1984: pl. 2, Figs 9–10) and Kaicher (card 3467) figured the holotype of *N. psila* and there are several differences between the two species: *N. psila* is smaller, has finer axial ribs on the early whorls and has no ribs on the ventral side of the last whorl. *Nassarius houbricki* sp. nov. has strong ribs on the early whorls as well as on the ventral side of the last whorl; it is also light in weight, but not ‘very thin’ as Kaicher (card 3467) describes *N. psila*.

Etymology

The species named in honor of the late Richard “Joe” Houbrick (1937–1993), Curator at the Mollusk Department at the National Museum of Natural History, Smithsonian Institution, in recognition for his extensive contribution to malacology (Harasewych and Kabat 1995). He was also the Ph.D. thesis advisor of the senior author’s son Silvard Kool.

Nassarius radians new species (Figs. 5 and 6)

Type material

Holotype MNHN IM 2007-31685; BOLD ID = NEOGA 1188-12; GenBank accession number for COI = KC970054 (Fig. 5A–C, H) (height 19.3 mm, width 9.8 mm). Ten paratypes MNHN, 2 paratypes HK171.01: Vanuatu, Canal du Second, SANTO 2006, stn AT82, 15°31.6’S, 167°12.4’E, 58–59 m, 1 dd, height 20.0 mm, width 10.8 mm (MNHN IM 2009-13091) (Fig. 5D–G); Vanuatu, North Urelapa Island, SANTO 2006, stn AT29, 15°35.9’–36.0’S, 167°01.3’–01.6’E, 83–90 m, 1 lv (MNHN IM 2007-31729); 1 lv (MNHN IM 2007-31686); Vanuatu, East Urelapa Island, SANTO 2006, stn AT41, 15°36.7’–37.0’S, 167°02.7’–02.8’E, 88–118 m, 3 dd (1 MNHN IM 2000-25430, 2 HK 171.01); Vanuatu,

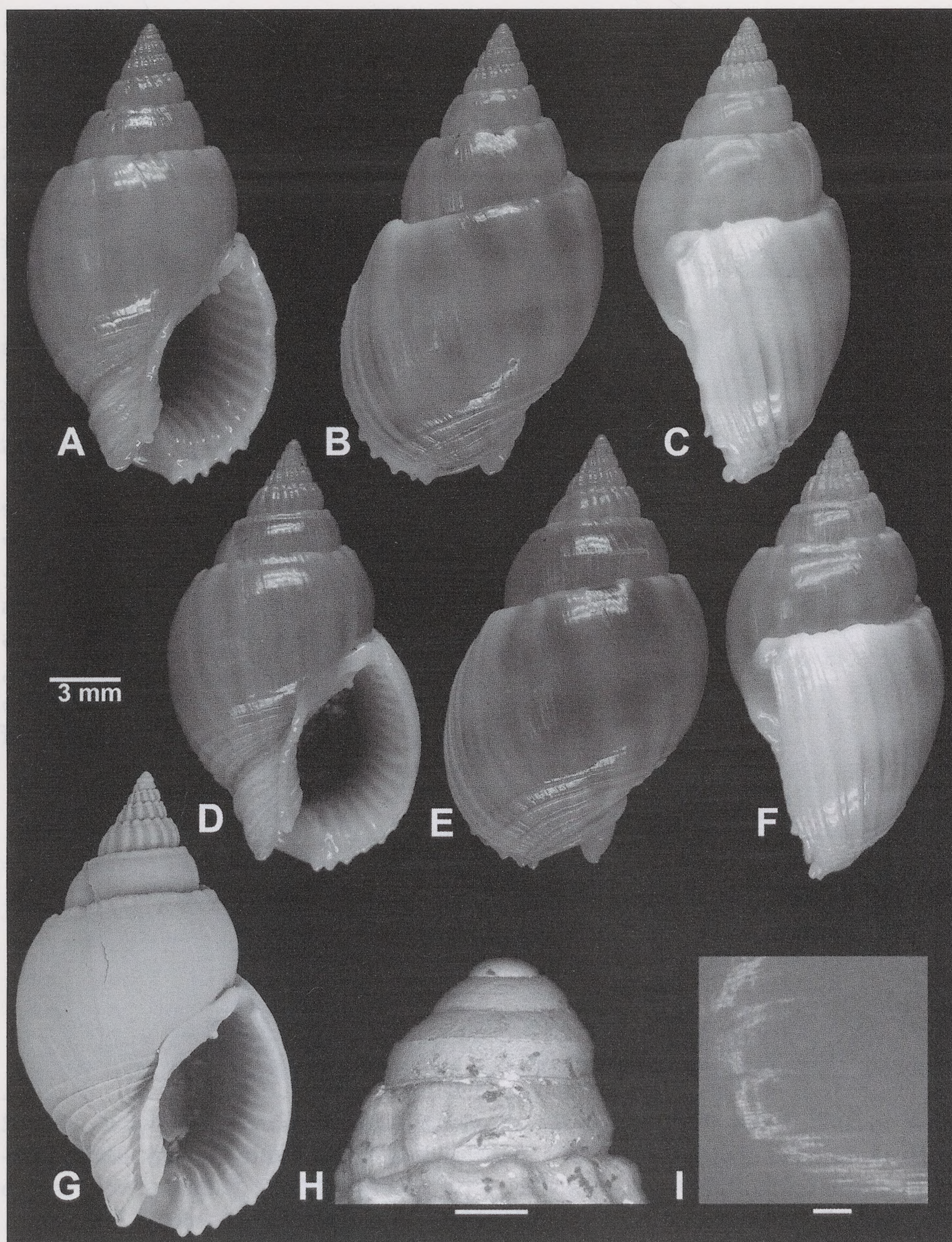


Figure 5. *Nassarius radians*, sp. nov. A–C, holotype MNHN IM 2007-31685, h 19.3 mm, w 9.8 mm, Vanuatu, Segond Channel, SANTO 2006, stn AT82, 15°32'S, 167°12'E, 58–59 m. D–G, paratype MNHN IM 2009-13091, h 20.0 mm, w 10.8 mm, Vanuatu, Segond Channel, SANTO 2006: stn AT82, 15°32'S, 167°12'E, 58–59 m. H, protoconch of the holotype. I, Enlarged shell sculpture. Scale bar: H and I = 250 µm.

Canal du Segond, SANTO 2006, stn AT53, 15°31.8'S, 167°13.6'E, 62–71 m, 1 lv (MNHN IM 2007-31656); 1 lv (MNHN IM 2007-31658); Vanuatu, Northeast Urelapa Island, SANTO 2006, stn AT119, 15°36'S, 167°02'E, 87–120 m, 1 lv (MNHN IM 2007-31659); 1 lv (MNHN IM 2007-31660); 1 lv (MNHN IM 2007-31672); 1 dd (MNHN IM 2000-25436).

Type locality

Vanuatu, Canal du Segond, 15°31.6'S, 167°12.4'E, 58–59 m [SANTO 2006, stn AT82].

Additional material (See supplemental document at: http://www.bioone.org/doi/suppl/10.4003/006.032.0202/suppl_file/Kool_2014_Suppl.pdf)

Description

Shell elongate ovate, extremely shining, height 19.3 mm, width 9.8 mm. Planktotrophic protoconch of 3.75 smooth whorls, last 1.5 carinated (Fig. 5H). Teleoconch of 5.5 whorls, first 3 axially ribbed, other ribs smooth. Suture deeply channeled. First three whorls with a subsutural spiral groove, axial ribs coronated. On next whorls subsutural spiral groove gradually indistinct, suture with undefined crenulations. Base of last whorl with 5 axially striated spiral grooves. Towards edge of outer lip 3–5 low axial ribs, lip not thickened, with 4–5 prominent denticles. Inside lip with 14 strong and deep lirae, siphonal area with 5 prominent, axially striated spiral grooves.

Columella laminate and with an abapical tooth, inside with 15 lirae. Parietal denticle strong, anal canal wide and prominent.

Color bright light brown (Fig. 5I) with darker axial streaks, more prominent at the suture, and with 2 lighter spiral bands on the last whorl. Outer lip and columella white, inside aperture brown.

Intraspecific variation: Dead collected specimens have lost their brilliant shine and are off white. Size varies from about 18.3 mm to 27.5 mm.

Distribution

Philippines, the Solomon Islands and Vanuatu (Fig. 6), alive at depths between 53–180 m.

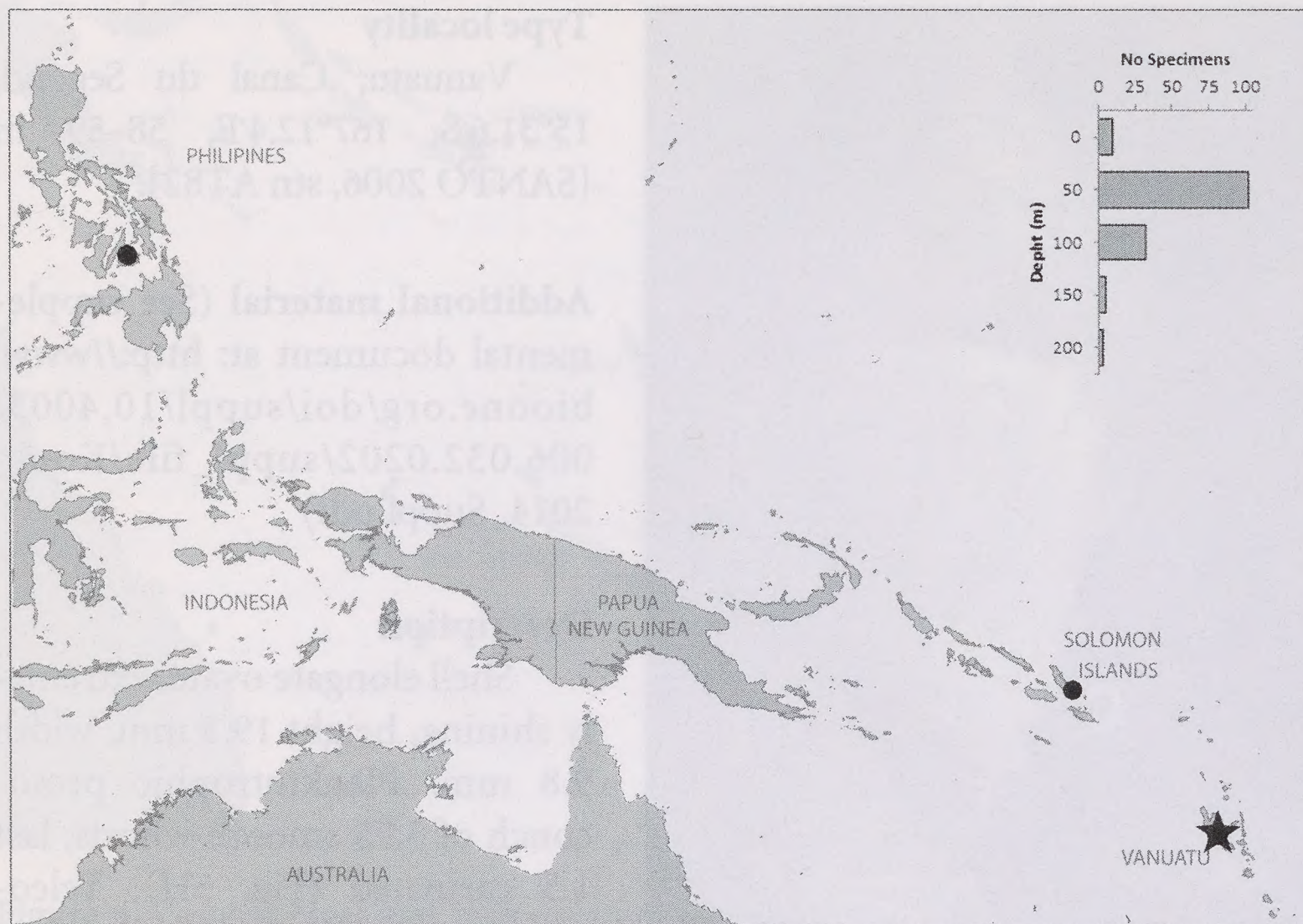


Figure 6. Geographical and bathymetrical distribution of *Nassarius radians* sp. nov. Each bar represents all lv or dd specimens. Star indicates type locality.

Discussion

Live-taken specimens of *N. radians* sp. nov. are easy to identify by their brilliant shine, the characteristic color pattern and the last 2 whorls of the shell which are nearly smooth. A species comparable with *N. radians* sp. nov. is *N. thachi* Dekker, 2004, which can be distinguished from *N. radians* sp. nov. by its more elongate shape and its size: up to 36 mm. Moreover, *N. thachi* has a clear subsutural groove. The recently described *Nassarius* (*Zeuxis*) *nanhaiensis* Zhang, 2013, from the South China Sea, at first sight, looks, very much like *N. radians* sp. nov. The latter differs however, in the number of protoconch whorls: 3.75 against 2–2.50 in *N. nanhaiensis*. The protoconch of *N. nanhaiensis* is described as smooth, whereas *N. radians* sp. nov. is prominently carinated. Other differences are the number of the axial ribs on the first 2 to 3 teleoconch whorls and the color of the shell. *Nassarius radians* sp. nov. is extremely glistening.

Another species with similarities with *N. radians* sp. nov. is *Nassarius comptus* (A. Adams, 1852) (Fig. 7A–D). *Nassarius radians* sp. nov. can be distinguished from *N. comptus* by the conspicuously different ribs on the three penultimate whorls: *N. comptus* has thick ribs, whereas the ribs of the new species are less prominent. The protoconch has fewer whorls, the callus is strictly limited to the columella and the shell is less shiny than in *N. radians* sp. nov.

The redescription of *N. comptus* by Cernohorsky (1984) is based on a taxonomic concept that includes several nominal species as synonyms, making comparison with *N. radians* sp. nov. somewhat problematic. The lectotype NHMUK 1969531/1 (Fig. 7A–D) designated by Cernohorsky (1984: 146), and the syntype NHMUK 1969531/2 (Fig. 7E–H) of *N. comptus*, are

illustrated here for the first time in color. A comparison of the lectotype of *N. comptus* with the holotype NHMUK 1973021 of *Nassa cinnamomea* (A. Adams, 1852) (Fig. 12G–H) shows that the latter is distinguished from *N. comptus* by its slenderer shape and the presence of a subsutural groove. They represent two different species in our opinion. The first three teleoconch whorls of the lectotype of *N. comptus* (Fig. 7C–D) are far more prominently ribbed than those of the syntype (Fig. 7G–H). Also the taller shape, the callus and the bands mismatch. In this respect, the paralectotype of *N. comptus* seems to be a specimen of *N. haldemani* (Dunker, 1847), which species is also illustrated in Fig. 12A–C.

The taxonomic status of *N. comptus* and the great number of taxa considered synonyms by Cernohorsky (1984: 146), correctly or incorrectly, is such a complex problem that it exceeds the objectives of the present paper and deserves a separate study for the future. Kool (2006: 98), supported on the discussion of Kase and Kinjo (1996: 199), already noticed the erroneous synonymisation of *Nassarius cinnamomea* with *N. comptus*.

Etymology

Nassarius radians sp. nov., from the Latin *radiare* = shine, named after its brilliant shine.

Nassarius vanuatuensis new species (Figs. 8 and 9)

Type material

Holotype MNHN IM 2007-31734; BOLD ID = NEOGA 362-10; GenBank accession number for COI = KC970062 (Fig. 8A–C, H) (height 6.7 mm, width 3.1 mm). Eleven paratypes MNHN, 3 paratype HK 173.02: Vanuatu, West Tangao Island, SANTO 2006, stn LD28, 15°35.4'S, 166°58.7'E, 3–8 m, 1 dd, height 6.4 mm, width 2.9 mm (MNHN IM 2009-13089) (Fig. 8D–G); 1 lv (MNHN IM 2007-31735); 1 lv (MNHN IM 2007-31786); 1 dd (MNHN IM 2000-25446); Vanuatu, Canal du Segond, SANTO 2006, stn EP03, 15°32.2'S, 167°09.06'E, 46 m, 1 dd (MNHN IM 2000-25441); Vanuatu, Canal du Segond, SANTO 2006, stn ED02, 15°31.07'S, 167°09.7'E, 18–21 m, 2 dd (1 MNHN IM 2000-25442, 1 HK 173.02); Vanuatu, Canal du Segond, SANTO 2006, stn ED17, 15°32'S, 167°10'E, 23–27 m, 2 dd (MNHN IM 2000-25443); Vanuatu, Tangoa Island, SANTO 2006, stn FB68, 15°35.4'S, 166°59.7'E, 11 m, 1 dd (MNHN IM-2000-25444); Vanuatu, Tangoa Island, SANTO 2006, stn LD27, 15°35.3'S, 166°59.3'E, 3–5 m, 3 dd (1 MNHN IM 2000-25445, 2 HK 173.01); Vanuatu, Tangoa Island, SANTO 2006, stn LD39, 15°35.4'S, 166°58.7'E, 6–9 m, 1 dd (MNHN IM 2000-25447).

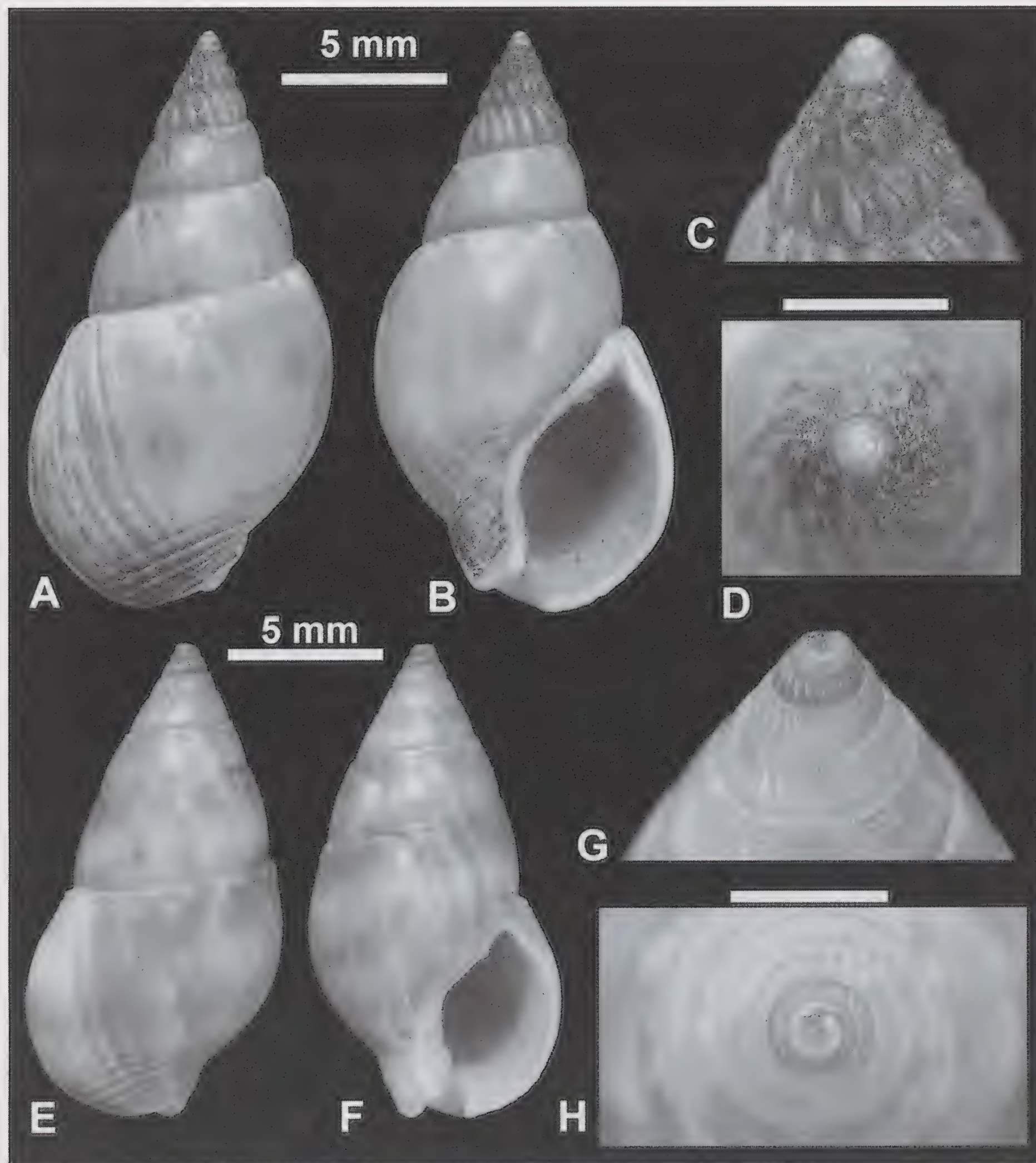


Figure 7. *Nassa compta* A Adams, 1852. A–D, lectotype NHMUK 19695311, h 18.8 mm, Cape St. Antonio, South Africa (= ? error). E–H, syntype NHMUK 19695312. Scale bar: C, D, G and H = 2 mm.

Type locality

Vanuatu, West Tangoa Island, 15°35.4'S, 166°58.7'E, 3–8 m [SANTO 2006, stn LD28].

Additional material (See supplemental document at: http://www.bioone.org/doi/suppl/10.4003/006.032.0202/suppl_file/Kool_2014_Suppl.pdf)

Description

Shell elongate, slender, height 6.7 mm, width 3.1 mm. Planktotrophic protoconch with 3 carinated, milky whorls (Fig. 8H). Teleoconch with 4.3, slightly convex whorls; penultimate whorl with 17 ribs, last whorl with 15 prominent ribs; varix strong. Suture moderately ledged; spiral sculpture

consisting of a deep subsutural groove, forming strong nodules on ribs at the suture; 3 to 4 overriding spirals on the first 3 teleoconch whorls; on last whorl, spirals are no more overriding the ribs, but only present in interspaces (Fig. 8I); 5 overriding basal cords, siphonal area with 4 to 5 cords.

Aperture oval, outer lip with about 10 lirae inside. Columella plicate throughout. Columellar callus well bordered, parietal denticle strong, anal channel deep and narrow.

Shell light brown, with 3 darker spiral bands, varix white.

Intraspecific variation: Color light brown to dark brown. Color bands can be absent or indistinct. Length varies from 6.0 mm to 8.3 mm.

Distribution

Nassarius vanuatuensis sp. nov. is only known from Vanuatu (Fig. 9), alive in 3–8 m. Empty shells are found regularly to 46 m; one shell in 127–193 m was most probably carried downslope.

Discussion

Nassarius vanuatuensis sp. nov. can be distinguished from species belonging to the complex of *Nassarius pauper* (Gould, 1850) by its carinate protoconch and by the slightly convex and more slender

shape of the shell. Additionally, species of the *pauper* group have secondary spirals between the more prominent primary ones.

Another comparable species also occurring in Vanuatu is *Nassarius moestus* (Hinds, 1844). This species was illustrated by Cernohorsky (1984: lectotype plate 42, Fig. 10) and Poppe (2008, color plate 357, Fig. 3). *Nassarius moestus* has lower axial ribs with over-riding spirals and a shiny, reddish-brown and not well-bordered callus, which extends partly over the body whorl. In addition, the shell of this species is similar in size to that of *N. vanuatuensis* sp. nov, but more convex.

Etymology

The species is named after the archipelago of Vanuatu, where the type locality is.

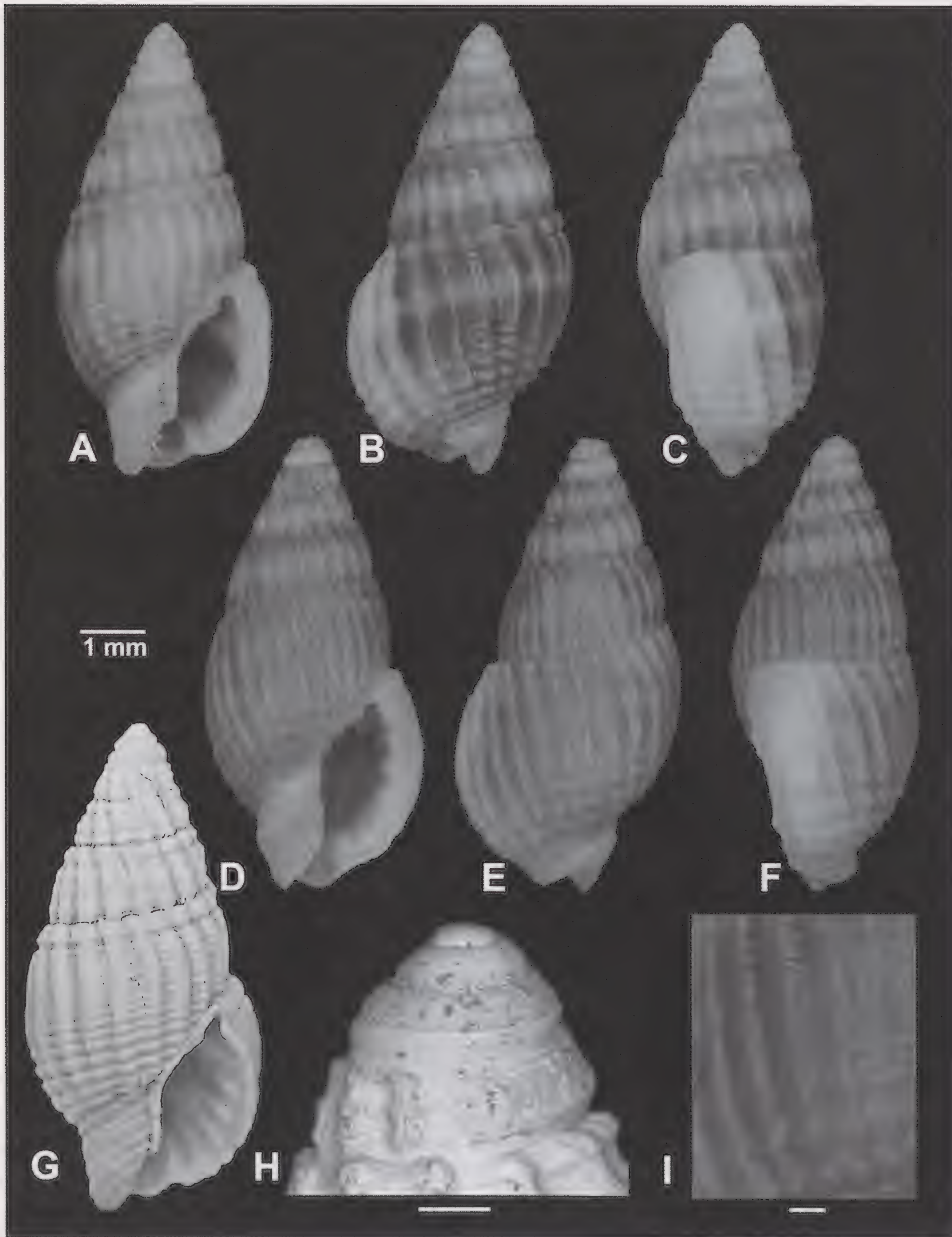


Figure 8. *Nassarius vanuatuensis*, sp. nov. A–C, holotype MNHN IM 2007-31734, h 6.7 mm, w 3.1 mm, Vanuatu, West Tangao Island, SANTO 2006: stn LD28, 15°35'S, 166°59'E, 3–8 m. D–G, paratype MNHN IM 2009-13089, h 6.4 mm, w 2.9 mm, Vanuatu, West Tangao Island, SANTO 2006: stn LD28, 15°35'S, 166°59'E, 3–8 m. H protoconch of the holotype. I, Enlarged shell sculpture. Scale bar: H and I = 250 µm.

Nassarius velvetosus new species
(Figs. 10 and 11)

Type material

Holotype MNHN IM 2007-31709; BOLD ID = NEOGA 1187-12; GenBank accession number for COI = KC970064 (Fig. 10A–C) (height 22.0 mm, width 10.1 mm). Seven paratypes

MNHN, 1 paratype HK 159.03: Vanuatu, South Urelapa Island, SANTO 2006, stn EN20, 15°37.2'S, 167°01.9'E, 85 m, 1 dd, height 22.8 mm, width 10.3 mm (MNHN IM 2009-13088) (Fig. 10D–H); 3 dd (MNHN IM 2000-25550); Vanuatu, Westnorthwest Urelapa Island, SANTO 2006, stn AT46, 15°38'S, 167°05'E, 92–104 m, 1 dd (MNHN IM 2000 25551); Vanuatu, Malo Island, SANTO 2006, stn LD20, 15°42.7'S, 167°15.1'E, 2–5 m, 1 dd (MNHN IM 2000-25552); Vanuatu, Southeast corner of Santo, SANTO 2006, deep water dredging, 2 dd (1 MNHN IM 2000-25553, 1 HK 159.03).

Type locality

Vanuatu, South Urelapa Island, 15°37'S, 167°02'E, 116 m [SANTO 2006, stn EN25].

Additional material (See supplemental document at: http://www.bioone.org/doi/suppl/10.4003/006.032.0202/suppl_file/Kool_2014_Suppl.pdf)

Description

Shell slender, elongate-ovate, velvety shining, height 22.0 mm, width 10.1 mm. Planktotrophic protoconch with 3.5 transparent whorls; the last keeled (Fig. 10H from paratype MNHN IM 2009-13088). Holotype's protoconch is incomplete. Teleoconch with 5.5 slightly convex whorls, first 3 finely ribbed and showing 4 to 6 fine spiral grooves. The rest of the whorls smooth, except a fine spiral groove below the suture and microscopic growth lines. Suture narrowly ledged.

Last whorl with 7 to 8 spiral grooves at the base and approximately 7 low ribs near outer lip. Outer lip with 4 to 5 denticles and approximately 15 evenly sized lirae inside, not variced and with a narrow edge of callus. Aperture oval. Columellar callus thick, margined and narrow, following the aperture from the siphon to the anal canal, anteriorly 2 to



Figure 9. Geographical and bathymetrical distribution of *Nassarius vanuatuensis* sp. nov. Each bar represents all lv or dd specimens. Star indicates type locality.

3 pustules. Parietal denticle strong. Anal canal prominent. Siphonal area with 6 to 7 grooves.

Shell white, scattered with brown, body whorl on dorsal side reddish-brown, darker near suture, lighter near outer lip with 2 faint bands. Aperture, outer lip and columellar callus white. Operculum (in paratype) yellowish, serrated.

After photography the protoconch and the anterior part of the outer lip of the holotype have been damaged.

Intraspecific variation: There is a rather great difference in color. Dead-collected shells lose the brown color and become

white, which hinders an accurate identification. Size of adult specimens varies from 15.1 to 25.5 mm.

Distribution

Nassarius velvetosus sp. nov. lives between 24–302 m from Vanuatu to New Caledonia. The occurrence in Fiji has to be confirmed with better quality additional specimens (Fig. 11).

Discussion

Some of the lots used here to describe *N. velvetosus* sp. nov. have already been mentioned by Cernohorsky (1991: 200), who misidentified them with *Nassarius comptus* (A. Adams, 1852). Specimens resembling *N. comptus* are frequently misidentified. However, the lectotype of *N. comptus* (Fig. 7A–D) shows strongly ribbed early whorls, whereas *N. velvetosus* sp. nov. has many fine ribs on the first 3 teleoconch whorls and is considerably more slender.

Cernohorsky (1991: 200) also misidentified another lot of *N. velvetosus* sp. nov. under the name *Nassarius haldemanni* (Dunker, 1847) (Fig. 12A–C). Dunker (1847: 62) described the species with the name “*Buccinum Halde-mani*” with a single ‘n’, evidently after the American malacologist Samuel Haldeman (1812–1880), although no etymology was given. The spelling *Nassarius haldemanni*, frequently used in literature, is a misspelling. The holotype of *N. haldemanni*, figured by Cernohorsky (1984: 283, Fig. 10), is considerably smaller in size (up to 14 mm) and has a smooth, carinated protoconch of 3 whorls; protoconch and first teleoconch whorl brownish.

A third resembling species is *Nassarius tangaroai* Kool, 2006 (Fig. 12D–F), which is smaller in size and has fewer and stronger ribs on the first apical whorls. It is known only from the Marquesas Archipelago.

Etymology

Velvetosus, Latinization of velvety. The velvety sheen of the shell inspired the name assignment.

Nassarius martinezi new species

(Figs. 13 and 14)

Type material

Holotype MNHN IM 2007-35021; BOLD ID = NASSA 005-12; GenBank accession number for COI = KC970038 (Fig. 13A–C, H) (height 18.9 mm, width 8.8 mm). Thirteen paratypes MNHN, 1 paratype HK 172.02: New Caledonia, Munida Bank, NORFOLK 2, stn CP2139, 23°01'S, 168°23'E, 372–393 m, 1 lv, height 19.6 mm, width 9.5 mm (IM 2007-35031) (Fig. 13D–G); 1 lv (MNHN IM 2007-35030); 1 lv (MNHN IM

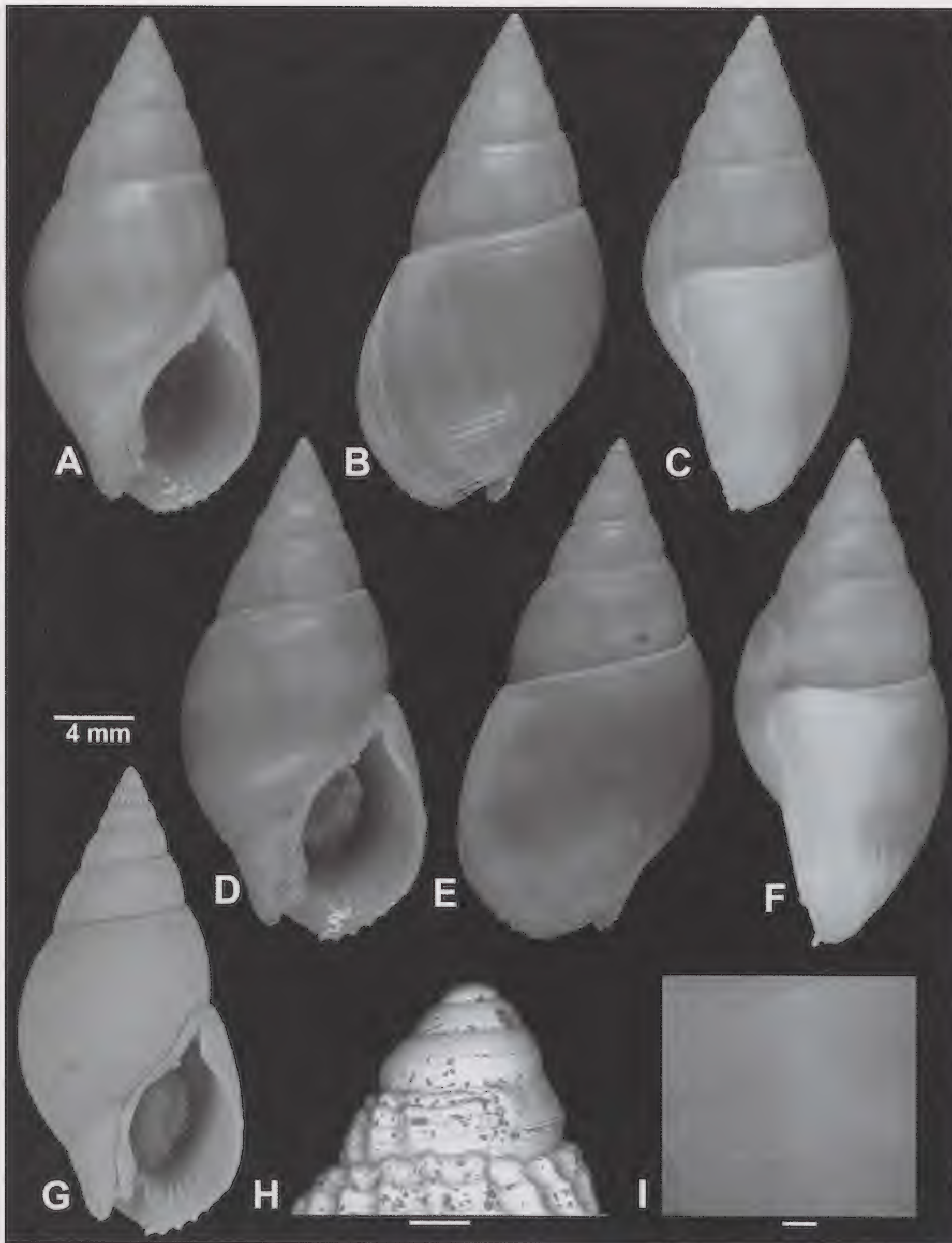


Figure 10. *Nassarius velvetosus*, sp. nov. A–C, holotype MNHN IM 2007-31709, h 22.0 mm, w 10.1 mm, Vanuatu, South Urelapa Island, SANTO 2006: stn EN25, 15°37'S, 167°02'E, 116 m. D–G, paratype MNHN IM 2009-13088, h 22.8 mm, w 10.3 mm, Vanuatu, South Urelapa Island, SANTO 2006: stn EN20, 15°37'S, 167°02'E, 85 m. H, protoconch of paratype. I, Enlarged shell sculpture. Scale bar: H and I = 250 µm.

2007-35032); 1 lv (MNHN IM 2009-12252); 1 lv (MNHN IM 2009-12253); 1 lv (MNHN IM 2009-12254); 1 lv (MNHN IM 2009-12255); 1 lv (MNHN IM 2009-12256), 1 lv (MNHN IM 2009-12243); 1 dd HK 172.02; New Caledonia, Norfolk Ridge, Munida Bank, TERRASSES, stn DW3108, 23°01'S, 168°23'E, 370–440 m, 1 lv (MNHN IM 2007-36807); New Caledonia,

Grand Passage, CONCALIS, stn CP3008, 18°30'S, 163°04'E, 275–305 m, 1 lv (MNHN IM 2007-34766); New Caledonia, Grand Passage, CONCALIS, stn DW2986, 17°59'S, 163°06'E, 270–300 m, 1 lv (MNHN IM 2007-34768); New Caledonia, PALEO-SURPRISE, stn DW1391, 18°30'S 163°03'E, 365 m, 1 dd (MNHN IM 2000-25567).

Type locality

New Caledonia, Norfolk Ridge, Munida Bank, 23°02'S, 168°21'E, 295–330 m [NORFOLK 2, stn DW2135].

Additional material (See supplemental document at: http://www.bioone.org/doi/suppl/10.4003/006.032.0202/suppl_file/Kool_2014_Suppl.pdf)

Description

Shell elongate, ovate, height 18.9 mm, width 8.8 mm, extremely thin, shining. Planktotrophic protoconch with approximately 3 carinated whorls (Fig. 13H). Teleoconch with 5 whorls with numerous narrow, flat, equally-sized axial ribs all over the shell, crossed by numerous, even so low spiral ribs, resulting in square to oblong interstices (Fig. 13B, I). Suture prominently ledged, with a subsutural row of fine granules.

Aperture oval, outer lip thin, edge somewhat turned backwards, anteriorly with 5–6 fine blunt denticles. Columella smooth and shiny. Columellar callus thin and passing into a thin and glazy enamel on part of ventral side of last whorl, nearly up to the suture. Parietal denticle nearly absent, anal canal wide. Siphonal area with eight ribs.

Shell white, with yellowish-brownish tinge all over the shell, except on the first 1–2 teleoconch whorls, the outer lip, the siphonal canal and the columella.

Variation: Color varies among different shades of brown. Some specimens have a white spire and yellow bands on the



Figure 11. Geographical and bathymetrical distribution of *Nassarius velvetosus* sp. nov. Each bar represents all lv or dd specimens. Star indicates type locality.

dorsal part of the last whorl. Some specimens are deeper channeled or have fewer axial and spiral ribs on the last whorl. Size from 11.5 to 20.0 mm.

Distribution

The species lives at depths of 168–372 m, from New Caledonia to the Solomon Islands, Fiji and Tonga (Fig. 14).

Discussion

The combination of sculpture and fragility of the shell are species-specific in comparison with other nassariid species. The shell of *N. houbrieki* sp. nov. is similar in shape but larger in size, thicker, with stronger axial ribs. *Nassarius alabasteroides* is larger and more elongate than *N. martinezi* sp. nov. which has a thinner shell. The sculpture of *N. noguchii* Habe, 1958 is somewhat comparable with that of *N. martinezi* sp. nov., but the shell of the former is smaller, not as thin and less fragile.

Etymology

Named in honor to Rafael “Guru” Martínez, Curator of the Mollusca Collection of the Central University of Venezuela who is considered to be the father of malacology in Venezuela after 50 years of research in the Caribbean Sea and teaching many marine biology students, including the second author of this paper.

Molecular section

We used COI sequences to support our species delimitation hypotheses primarily based in morphological recognition. Ninety one partial sequences of 658 bp were unambiguously aligned without gaps. Two hundred fifty one were found to be variable positions of which 229 were parsimony-informative.

The intra-specific genetic variability among the *Nassarius* included in present study is between 0 and 0.019 (Fig. 15). The results agree with what has been found for different gastropod species. For instance, among nassariids the intra-specific variation varies between 1% within *Nassarius reticulatus* (Linnaeus, 1758) (Couceiro *et al.* 2007), 1.1% within *Nassarius nitidus* (Jeffreys, 1867) (Couceiro *et al.* 2012) and 2.5% for *Cyplope neritea* (Linnaeus, 1758) (Simon-Bouhet *et al.* 2006). Barcode gap is 2.5% in different genera of Conoidea (Puillandre *et al.* 2009, 2010). Barco *et al.* (2013) has reported comparable results for intra-specific variability among the genus *Gibbula* Risso, 1826 (0–0.278).

The taxonomic tree is presented in Figure 16. *Nassarius ocellatus* sp. nov. appears as a monophyletic group and distinct from *N. praecallosus* (Marrat, 1877), its sister-species. Sequences of *N. multigranulosus* are not available for molecular comparison. K2P Genetic distances between the two species span from 4.2 to 5.9%, similar to those distances generally found between different gastropod species (Li *et al.* 2010, Kantor *et al.* 2012).

Comparison between sequences of *N. houbrieki* sp. nov. and *N. siquijorensis* reveals 6.2 to 7.1% genetic divergences. Sequences of *N. alabasteroides* and *N. psila* are not available. The closest molecular species is another undescribed species, with genetic distances to *N. houbrieki* sp. nov. comprised between 4.4 to 5.5%

Comparisons of genetic distances between *N. radians* sp. nov. with *N. thachi* (5.3–5.6%), *N. cf. comptus* (7.4–8.7%), *N. cf. cinnamomea* (6.7–7.8%) and *N. haldemani* (8.5–8.9%) support our species delimitation. *N. acuminatus* (Marrat, 1880) is the closest molecular species to *N. radians* sp. nov., with genetic distances between 3.5 and 3.8%. COI sequences are not available for *N. nanhaiensis*.

Although morphologically similar to *N. pauper* (genetic distances between 19.5 and 19.9%), *Nassarius vanuatuensis* sp. nov. does not belong to the *pauper* complex as discussed in Kool and Dekker (2006, 2007) (Fig. 16). The closest species is *N. haldemani* with genetic distances from 9.4 to 9.6%. No COI sequence is available for *Nassarius moestus*.

The differences in terms of genetic distances between *Nassarius velvetosus* sp. nov. and *N. cinnamomea* (7.8–9.5%), *N. cf. comptus* (7.7–9.4%) and *N. barsdelli* Ladd, 1976 (4.6–4.8%) support our species hypothesis. Comparison with *N. tangaroai* was not possible. *N. velvetosus* sp. nov. is related to a not yet described species (with distances of 5.6–6.4%).

Although the comparison with *N. alabasteroides* was not possible, sequences of *N. martinezi* sp. nov. were different enough from those of *N. houbrieki* sp. nov. (genetic distances between 6.8 and 7.4 %) and *N. noguchii* (4.4–5.0%) to

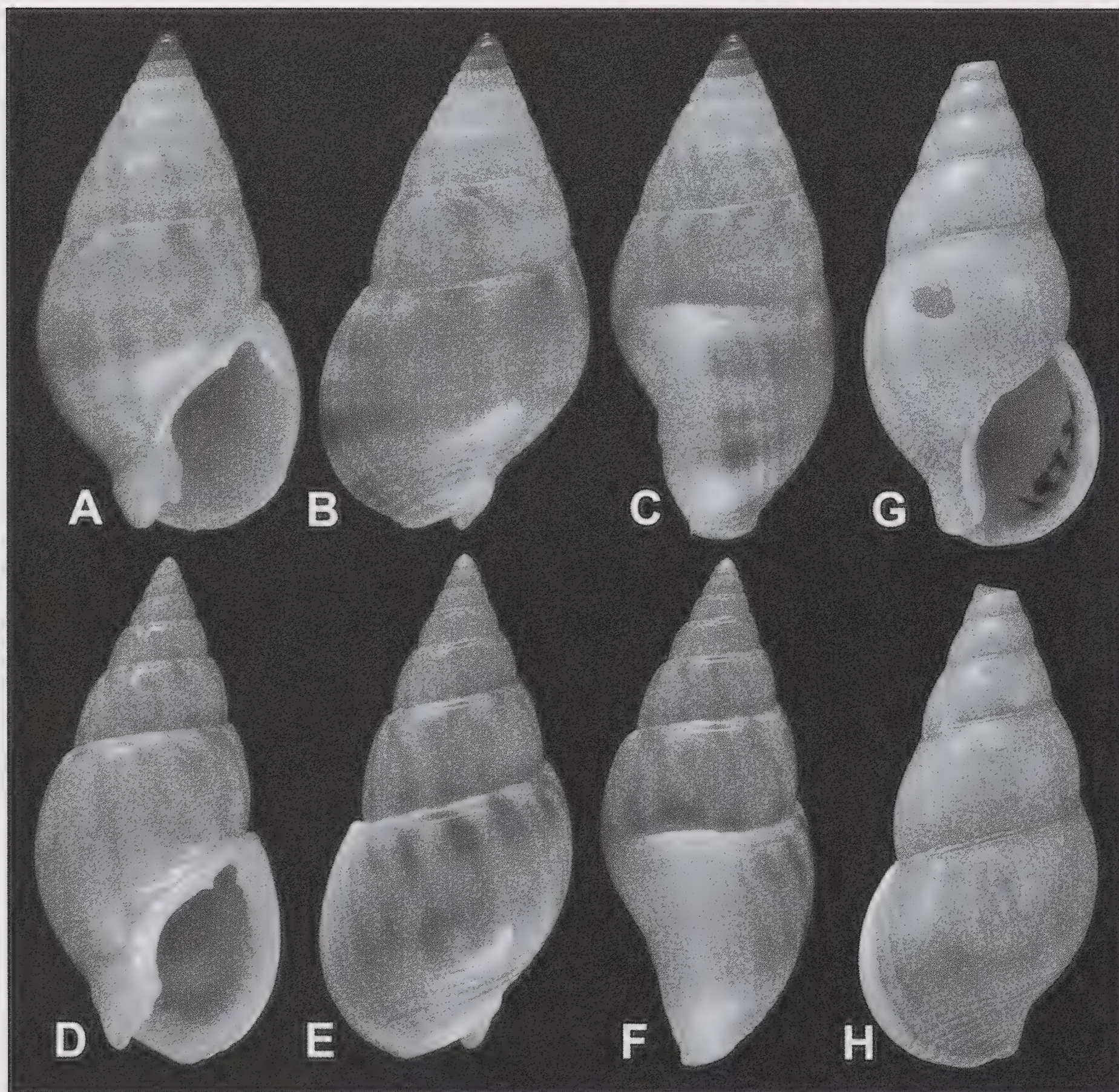


Figure 12. *Nassarius haldemani* (Dunker, 1847). A–C, h 12.9, w 6.3 mm (HK 874.04), Indonesia, Celebes Sea, N. Sulawesi, near Pulau Balabangan Group, 02°26'S, 117°25'E, 5–25 m. *Nassarius tangaroai* Kool 2006. D–F, holotype MNHN 9920, h 16.7, w 7.4 mm Marquesas Archipelago, MUSOR-STOM 9: stn DW1224, 9°45'S, 138°51'W, 115–120 m. *Nassa cinnamomea* A. Adams. G–H, holotype NHMUK 1973021, h 23.8 mm, w 11.4 mm, Philippines, Dumaguete, Negros Island.

support our species delimitation. The other two closest related taxa are *N. haldemani* and an undescribed species, the genetic distances of which range between 8.0–8.6 and 3.3–3.9%, respectively.

DISCUSSION

Considering the relative abundance and the ecological importance of the species belonging to the family Nassariidae, the taxonomic status of many species remains uncertain. Within nassariids, name assignment represents a difficult challenge due to the fact that genera and species delimitation can be confusing in many cases. Species may have small morphological inter-specific differences (e.g., the group of

Nassarius pauper (Gould, 1850), see Kool and Dekker 2006, 2007), which might lead to merge together closely related species under the same name (e.g., *Nassarius comptus* (A. Adams, 1852), see the discussion under *Nassarius radians* sp. nov.), with numerous misidentifications and sometimes long lists of synonyms (Cernohorsky 1984).

Characters informative for nassariid species recognition are currently almost exclusively based on shell features. Cernohorsky (1984) and Haasl (2000) discussed those characters and their limits (some subgenera could be identified by the radula) suggesting the need for further sources of data. To traditional taxonomic practices, the description of new nassariids has lately been confirmed by different molecular approaches. Studies on cryptic *Nassarius* species COI and 16S fragments (Li *et al.* 2010, Couceiro *et al.* 2007, 2012, Chen and Zhang 2012) have already been used. The main limitation of molecular approach is the lack of a robust dataset for comparison among monophyletic groups.

The ranges of intra- and inter-specific genetic distances calculated for our new species, are congruent with the usage of barcode gap in nassariids (Simon-Bouhet *et al.* 2006, Couceiro *et al.* 2007, 2012, Li *et al.* 2010). For all the species described, the range of values of intraspecific divergence and the Bayesian tree confirmed the morphological discrimination made *a priori*. Even more, our threshold represent a value similar to those often found among gastropods (Puillandre *et al.* 2009, Kantor *et al.* 2012, Barco *et al.* 2013), reaffirming the utility of the DNA barcode to test species hypotheses delimitation.

We chose name-bearing types that are also hologenophores, to avoid the perpetuation of a molluscan taxonomy where many holotypes do not fulfill their function of name bearers (Bouchet and Strong 2010). The sequences obtained from the specimens support our taxonomic hypothesis concerning the new species formulated from morphological observations.

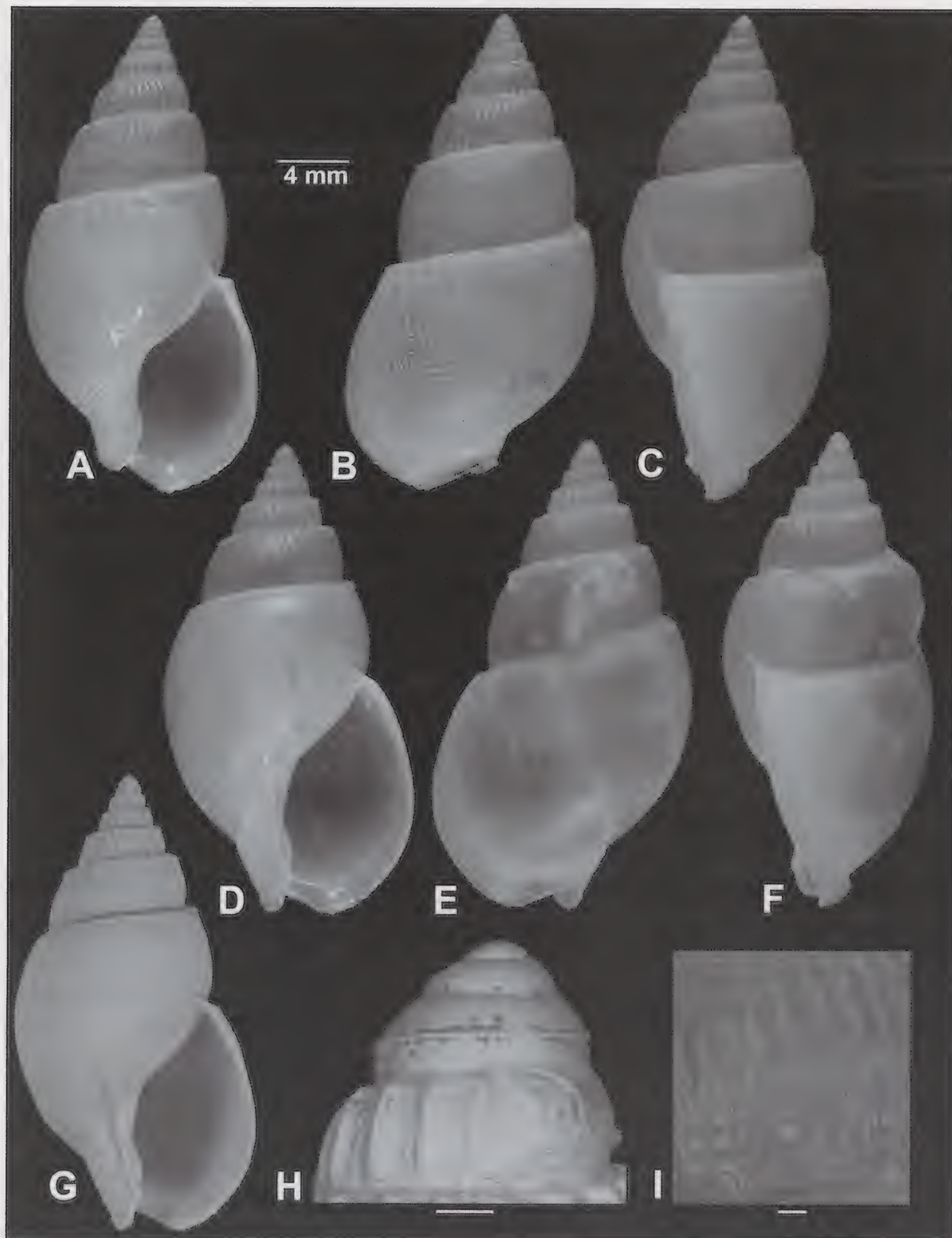


Figure 13. *Nassarius martinezi* sp. nov. A–C, holotype MNHN IM 2007-35021, h 18.9 mm, w 8.8 mm, New Caledonia, Munida Bank, NORFOLK 2: stn DW2135 23°02'S, 168°21'E, 295–330 m. D–G, paratype MNHN IM 2007-35031, h 19.6 mm, w 9.5 mm, New Caledonia, Munida Bank, NORFOLK 2: stn CP2139, 23°01'S, 168°23'E, 372–393 m. H, protoconch of the holotype. I, Enlarged shell sculpture. Scale bars: H and I = 250 µm.

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Figure 14. Geographical and bathymetrical distribution of *Nassarius martinezi* sp. nov. Each bar represents all lv or dd specimens. Star indicates type locality.

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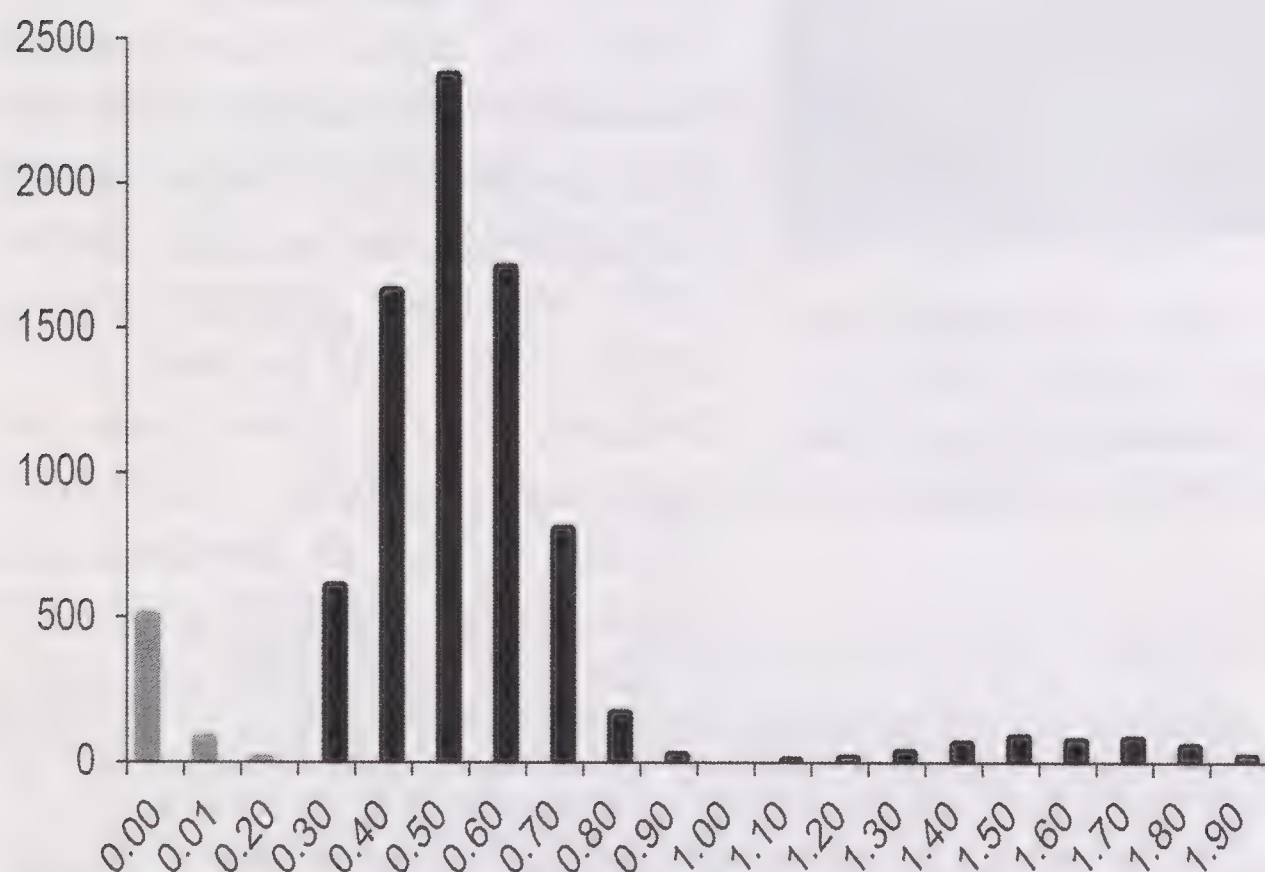


Figure 15. Frequency of pairwise distance (K2P model) values among COI sequences. In gray, intra-specific variation. In black interspecific variation.

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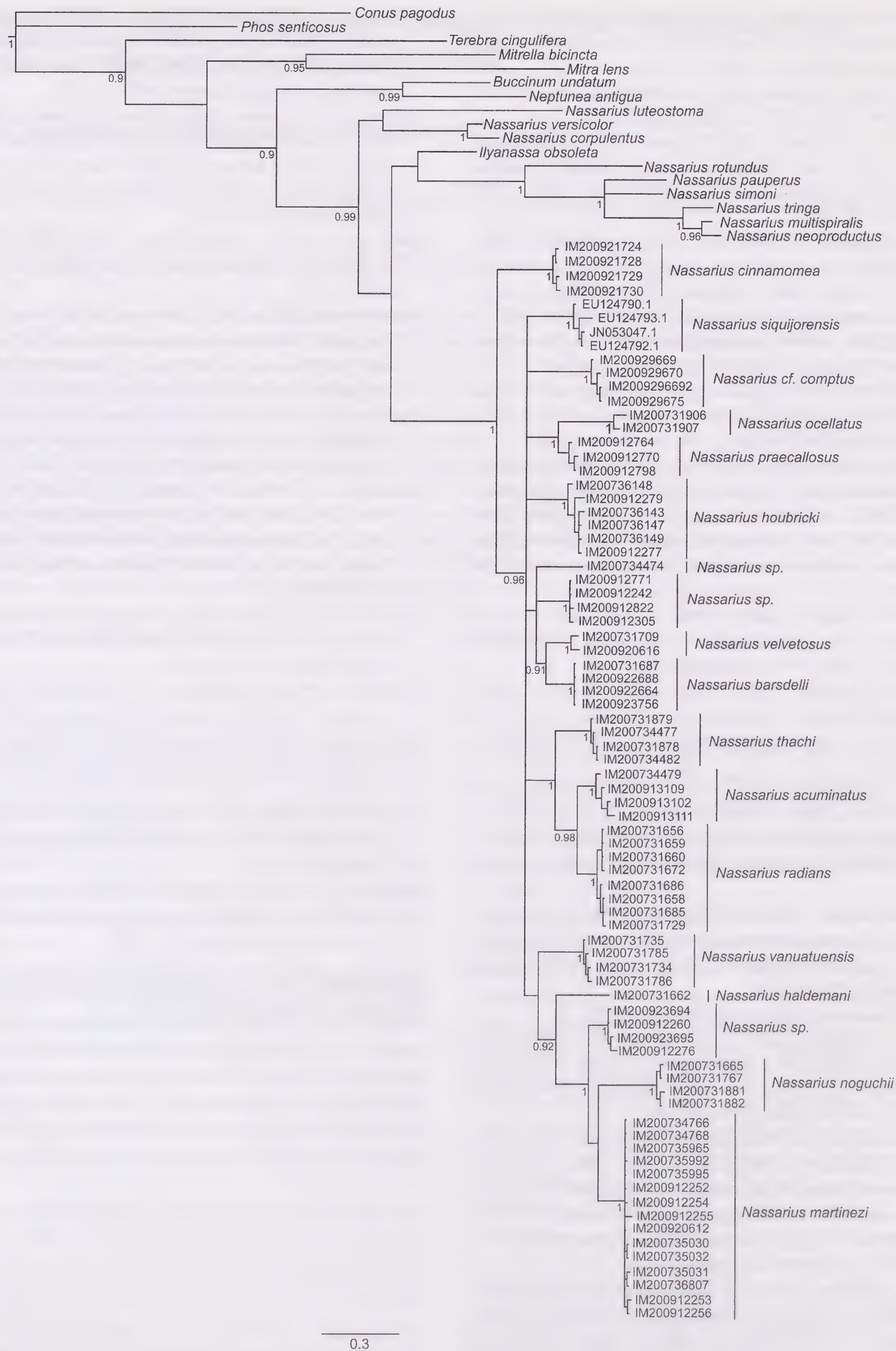


Figure 16. Bayesian tree based on COI sequences from the 6 new species of *Nassarius* described in comparison with possible related species.

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